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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(57) Abstract		
<p>An apparatus for recording in the mouth and the reproduction in the laboratory of the position of the dental arches in relation to the condylar axis, specific for the applications in the field of dentistry and dental technique. It includes a metal plate (1), a graduated rod (3) for the support of the plate (1), an occlusal plane (5) provided with goniometers (10), an articulator (29), a graduated rod (18) that supports the metal plate (1)-rod (3)-assembly on the base (11). The apparatus allows for the registration in the mouth and the reproduction in the laboratory of the values of the numerical coordinates that indicate the position of the plate (1) to the condylar axis of the patient.</p>		

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**APPARATUS SUITABLE FOR RECORDING IN THE MOUTH AND FOR REPRODUCING IN THE LABORATORY THE POSITION OF THE DENTAL ARCHES IN RELATION TO THE CONDYLAR AXIS, SPECIFIC FOR APPLICATIONS IN THE FIELD OF DENTISTRY AND DENTAL TECHNIQUE.**

**DESCRIPTION**

The object of this invention is a new apparatus which is suitable for recording in the mouth the position of the dental arches in relation to the condylar axis and for reproducing this same position in the technician's lab.

5

The field of the invention in question is that of the equipments or devices that are used, in dentistry and dental technique, for the fabrication of dental restorations at large. For this kind of applications it is necessary to measure and to reproduce, as accurately as possible, the position of the dental arch in relation to the condylar axis. This position is a key factor for building the restoration correctly.

10

The instruments that are now used for this purpose, which are better known as "facebows", show on the one side some reference points to the condylar axis (the so-called "occlusal planes") and, on the other side, a metal plate covered with wax, which serves to get the impressions of the teeth. Moreover, in order to adapt the instrument to the different face anatomies, the metal plate is mounted loose on its occlusal plane and is fastened to this plane with screws or other reversible means.

15

The conventional devices described above show a fixed connection between the metal plate and the occlusal plane. Their main feature is that they are made in one single piece. This is to be put down to the fact that conventional devices do not make it possible to separate the metal plate from the occlusal plane without losing at the same time the position of the dental arch that had been previously recorded.

20

This structural need brings a disadvantage both to the dentist and to the dental technician. In fact the dentist has to have as many complete facebows in the dental office as are the measurements that have to be done. On the contrary, it would be easier to always use the same occlusal plane and to replace on this plane only the metal plate. The dental technician, for his part, needs to transfer the whole equipment to the laboratory, but has

to face problems of volume and dimensions and runs the risk that - because of shocks or other reasons - the correct position of the metal plate in relation to the occlusal plane might be lost during transportation (due to the articulated connection between these parts).

5

Moreover, another drawback is that, with the usual face-bows, after fabricating the restoration the following measurement on a different face anatomy implies the irretrievable lost of the previous record. For this reason with all present devices it is not possible to get a "memory" of the position of the dental arch (for example, for fabricating several restorations for the same patient at different times), but every time it is necessary 10 to take again the measurements that had already been taken before.

10

Also, after being transferred to the technician's lab, the face-bow has to be mounted in an articulator that has to be compatible with the face-bow itself. For this reason the dental 15 technician needs to have in the laboratory all possible different combinations of articulators and face-bows, with evident problems of costs and working troubles. In fact, if there should be something wrong with the equipment or for any other reason, the replacement of the face-bow has to correspond to the replacement of the articulator, if the face-bow is of a different kind compared to the previous one and vice versa.

20

The main purpose of this invention is to offer a new apparatus for recording and reproducing the position of the dental arch in relation to the condylar axis. This apparatus, in comparison to the usual facebows, is easier and more practical to use and is also compatible with all different kinds of articulators in commerce.

25

These and other purposes have been reached with this apparatus according to claim 1. Some favourite manufacturing forms of the same apparatus result from the remaining sub-claims.

30

In comparison to the usual devices, the apparatus according to this invention makes it possible to separate the metal plate from the occlusal plane, anyway without losing the record taken on the position of the dental arch in relation to the condylar axis. In this way it is no longer necessary to have as many complete sets of instruments as are the restorations to be fabricated. Moreover the dental technician can take only the metal plate 35 to the laboratory and leave the occlusal plane in the dental office. Thus the space and the volume occupied by the transported device is considerably reduced and above all there

isn't any risk that the records that the dentist has taken in the mouth might be modified during transportation.

This invention also allows the dentist to register the data on the position of the dental arch. These registrations can be kept and re-used, thus avoiding the conventional need for taking the measurements again, even for the same face anatomy, if more restorations are fabricated at different times.

The apparatus of this invention is universal and can be used with all different articulators used by dental technicians.

These and other purposes, features and advantages result from the following description of the apparatus according to this invention, given with reference to the drawings enclosed that illustrate, as a non restrictive example, a favourite manufacturing variation of the invention itself. In these drawings, which are an integral part of this description:

- picture 1 shows in perspective the apparatus according to this invention, that has been broken down into its main parts;
- picture 1a shows the equipment of picture 1 seen from A;
- picture 2 shows the parts of the apparatus of picture 1, assembled together to record the position of the dental arch;
- picture 3 shows the occlusal plane of the apparatus of picture 2;
- picture 4 shows the detail of the goniometer that is located on the occlusal plane of picture 3;
- picture 5 shows the detail of the metal plate and its supporting rod on the occlusal plane of picture 3;
- picture 6 shows the use of the apparatus of picture 2;
- pictures 7 and 8 show the measuring technique of the values of the dental arch position by means of the goniometer of picture 4;
- picture 9 shows the parts of the apparatus of picture 1, assembled together to reproduce the position of the dental arch in the laboratory;
- picture 10 shows the supporting device of the articulator of the apparatus of picture 9;
- picture 11 shows the detail of the fastening system of the metal plate to the supporting device of picture 10;
- picture 12 shows the ground plane of the articulator supported by the device of picture 10;

- pictures from 13 to 17 show some manufacturing variations of the apparatus of the previous pictures.
  - picture 18 shows another variation of the apparatus of the invention.
- 5      The apparatus according to the invention, shown in picture 1, is made up of the following main parts:
- a metal plate 1;
  - a graduated rod 3 supporting plate 1;
  - an occlusal plane 5 supplied with goniometers 10;
  - 10     - an articulator 29;
  - a graduated rod 18 supporting the metal plate 1-rod 3-assembly on base 11;

The parts that are used by the dentist to record the position of the dental arch are shown in pictures 2 to 5.

15     The metal plate 1 is provided, on its anterior portion 31 (picture 5), with an articulated attachment head 2 to the corresponding female seat 4 which is located at the end of a graduated rod 3. This in turn is suitable for sliding, with its end opposite to the one supporting plate 1, into a seat 6 provided in a support 42 of the occlusal plane 5. Ideally, 20     rod 3 has a polygonal structure or shows protuberances that prevent its rotation insided the above-mentioned seat 6.

25     The occlusal plane 5 has a basically U-shaped structure, that shows, on its transversal arm or bottom 32, the above-described seat 6 for rod 3. The lateral arms 33, 34 of plane 5, on the contrary, show some fulcrums that are identified by hollow seats, 7 and 8 respectively. These fulcrums in turn are suitable for housing the graduated sliding rod 35 of the corresponding goniometers 10.

30     For the use by the dentist of the equipment that has been described up to this point (pictures 6 to 8), on the metal plate 1 a suitable thickness of wax is applied (not illustrated in the picture) and is then introduced into the patient's mouth, so that it can receive the impression of the dental arch. At this point the articulated head of rod 3 is connected to its female seat 4 of portion 31 of the metal plate 1 that protrudes out of the mouth.

With rod 3 bound to plate 1, the occlusal plane 5 is oriented with the lateral arms 33 and 34 placed beside the ears (picture 6), by introducing at the same time rod 3 into its seat 6 on the same occlusal plane 5. The fulcrums 7 and 8 are brought to the level of the patient's condylar axis 36 (pictures 6 and 8), at the same time lining up with the bipupillary plane 43.

After reaching this position and using a suitable resin, the dentist definitely locks head 2 in its seat 4: thus the position of the metal plate 1 is fixed in relation to the graduated rod 3. At this point he tries to achieve the alignment of fulcrums 7 and 8 on the condylar axis 36, by having rod 3 slide into seat 6 of the occlusal plane 5.

When tragus 37 of the patient's ear (which is located at a known distance from the condylar axis 36) coincides with the corresponding contour 9 drawn on goniometer 10 (pictures 4 and 7), the dentist will tighten the screw 12 that locks rod 3 in its seat 6 on the occlusal plane 5 and records, on the graduated scale 16, the length L of the rod 3 that protrudes out of the same seat 6. In this way the position of the condylar axis is defined, that coincides with the notch 13 of goniometer 10 (pictures 4 and 7).

Starting from this position of the apparatus of the invention, the distance H of the notch 13 of the goniometer 10 from the occlusal plane 5 and the angle  $\alpha$ , still in relation to this plane, of a straight line 38 that joins the same notch 13 and the point 14 positioned in the lower part of the eye 15 are read.

Ideally, as it is better described in picture 7, goniometer 10 is fabricated out of a clear material, so that the angular position of point 14 can be read on the goniometer itself.

After recording the values L, H and  $\alpha$ , it is possible to take rod 3 out of seat 6 on the occlusal plane 5, with plate 1 locked in the readout position of these values. From now on the occlusal plane and its goniometers are available for being used on another patient.

The dental technician who has to fabricate the restoration receives the metal plate 1 that is rigidly fixed on the rod 3, together with the values L, H,  $\alpha$  that have been recorded on the patient by means of the above-described device.

The metal plate 1- graduated rod 3- assembly is now transferred on the equipment parts that are illustrated in pictures 9 to 12.

- These include a base 11, that basically reproduces the shape and functions of the occlusal plane 5 and that shows a seat 17 in which a sliding graduated rod 18 is housed, that is perpendicular to the (usually horizontal) plane, containing the base 11 itself. Also rod 18, like rod 3, has a shape or shows some protuberances that prevent the rotation around its axis, after being housed in the mentioned seat 17. Moreover, rod 18 has a graduated scale 19, on which the height H can be read, that has been previously measured with goniometer 10 (picture 11).
- On the end of rod 18 that is in the opposite position compared to the end that is engaged in the mentioned seat 17, a seat 20 is built that houses, like seat 6 of the occlusal plane 5, the sliding graduated rod 3, on which the metal plate 1 is fixed. The operator has rod 3 slide into this seat 20 until the length L that has been previously recorded on the patient can be read on the graduated scale. A screw 41 serves for locking rod 3 in this position.
- On the ends 39 and 40 of base 11 (picture 11) one goniometer 21 is fixed on each side. On these goniometers, a hollow seat 22 that coincides with the notch 13 of goniometers 10 defines the position of the condylar axis 36. Inside these seats 22 the sliding pins or condylar rods 23 and 24 are housed (picture 10) that can be locked, in relation to goniometers 21, by means of screws 25 and 26.
- To the user's advantage, the end of the pins 23, 24, that is external to goniometers 21, is provided with a knob 27 for the manual hold of the pins themselves.
- A jaw-shaped articulator 29 (picture 10) is clamped between the ends 28 of pins 23 and 24. The correct centering position of articulator 29 in relation to goniometers 21 is achieved by guiding reference 44 of the transversal rod 45 onto a corresponding index (non illustrated) of articulator 29 (pictures 1a and 12). For this purpose screws 25 and 26 are unloosened, in order to adjust the distance between pins 23 and 24, so that between the ends 28 of these pins the articulator 29 can be housed. In this way one can also use articulators with different dimensions, with no need of changing the supporting base. By tightening the screws 25, 26 the articulator is locked in relation to the pins and to base 11.
- The articulator 29, at this point, can be rotated until the angle  $\alpha$ , that had been previously recorded on the patient, can be read on goniometers 21. For a better illustration of this

angle, in pictures 1 and 9 only the plane taken by articulator 29 has been illustrated. By means of a incisal rod 30 this angulation can be maintained during the following working steps.

- 5 In this angular position of articulator 29 the metal plate 1, that is now carrying the stone model of the teeth, is housed inside the articulator itself (picture 12). From now on the fixation of the model with plaster is carried out, according to conventional techniques, in the upper part of the articulator which is always positioned in  $\alpha$ . After the plaster has set, the equipment is disassembled and it is ready for use in another plate 1-rod 3-assembly  
10 of a different record.

The metal plate that is now carrying the stone model can be kept, together with the measurements of L, H, and  $\alpha$  and be recorded, in order to be used again for the fabrication of new restorations, at different times, for the same patient.

- 15 In the manufacturing variation shown in pictures 13 to 17, on rod 3 a cross 46 is mounted, the vertical arm 47 of which is perpendicularly fixed in hole 51 (picture 14) of the rod 3, while the horizontal arm 48 is mounted at a certain height on the same arm 47.
- 20 As it is shown in picture 17, the apparatus according to this invention is used by clamping plate 1 between the dental arches. Starting from this position, the horizontal arm 48 is lined up with the bipupillary plane 43 and the vertical arm 47 is lined up with the middle line 52 of the patient's face. After reaching this position of the occlusal plane 5, that corresponds to the correct centering of plate 1 in relation to the dental arch, the  
25 position L of rod 3, the distance H of the notch 13 of goniometer 10 from the occlusal plane and the inclination  $\alpha$ , in relation to the occlusal plane, of the straight line 38 that joins the mentioned notch 13 (defining the position of the condylar axis) and the point 14 that is located in the lower portion of the eye 15 are read (picture 16). After recording the values L, H and  $\alpha$ , the rod 3 is taken out of the occlusal plane and used for building the  
30 stone model of the teeth.

As illustrated in picture 14, plate 1 is connected to rod 3 by means of an articulated joint, combined with two pre-fracture arms 49 and 50, that are placed sideways on joint 2.

Through this double connecting system, if the metal plate 1 should already be centered in relation to the dental arches, this position would be maintained by the mentioned arms 49 and 50.

- 5 On the contrary, when adjustments or corrections have to be made to the position of plate 1, the mentioned arms 49 and 50 can be broken; in this way it is possible to exploit the freedom of oscillation of plate 1 with respect to rod 3, enabled by the articulated joint 2, to achieve the correct centering.
- 10 Moreover, to the user's advantage, in order to give the necessary and correct horizontal position to the occlusal plane 5 while the position of the dental arches is recorded, this plane 5 can be supplied with a suitable water level (not illustrated).

15 According to the manufacturing variation of picture 18, the supporting device of articulator 29 is provided, on base 11, with an arm 46 that carries one hinged end of the articulator itself. The opposite end of this articulator shows, in a position that is adjustable through the fastening screw 47, the mentioned incisal rod 30, that is suitable for resting, with its lower end, on the sliding bearing plane 48 of the graduated rod 18.

- 20 By selecting the height of this rod on base 11, as it has been previously described, the inclination  $\alpha$  of the articulator 29 is also selected. This inclination is read directly on the graduated scale 49 provided on the mentioned bearing plane 48 for the incisal rod 30 on the graduated rod 18. In this way it is possible to reproduce in the laboratory the position of the dental arches, by directly reading the angle  $\alpha$  on the graduated rod 18 and with no need for the goniometers 21 that are present according to the manufacturing version of picture 9.

CLAIMS

1. Apparatus for the fabrication of dental restorations, characterized by the fact that it offers means for recording in the mouth and reproducing in the laboratory the position of the dental arches in relation to the condylar axis.
- 5 2. Apparatus according to claim 1, characterized by the fact that the mentioned recording means include an occlusal plane (5) and some instruments for measuring the position of the said dental arches in relation to the occlusal plane itself.
- 10 3. Apparatus according to claim 2, characterized by the fact that these instruments consist of a plate (1) suitable for taking the impression of the teeth, that can be adjusted in different positions with respect to the mentioned occlusal plane (5), provided with goniometers (10) that can be adjusted in height in relation to the same occlusal plane (5) and are suitable for giving a reference to the position of the condylar axis (36).
- 15 4. Apparatus according to claim 3, characterized by the fact of having a graduated rod (3) on the mentioned occlusal plane (5) that supports the said plate (1) through, on the one side, an articulated joint (2,4) with the plate itself (1) and on the other side through a sliding connection of the mentioned rod (3) with the said occlusal plane (5).
- 20 5. Apparatus according to claim 4 characterized by the fact that it has, on the said occlusal plane (5) a seat (6) for housing the sliding rod (3) mentioned above, this rod being provided with a graduated scale (16) for reading the position (L) of plate (1) in relation to the occlusal plane (5).
- 25 6. Apparatus according to claims 3, 4 or 5, characterized by the fact that the mentioned goniometers (10) have a graduated rod (35) for reading the position (H) of the goniometers themselves in relation to the occlusal plane (5) and a reference (9) that reproduces the contour of the tragus (37) of the patient's ear and a notch (13) that indicates the position of the condylar axis (36).
- 30 7. Apparatus according to claim 6, characterized by the fact that the mentioned goniometers (10) are made of a clear material, in order to allow for the readout of the inclination ( $\alpha$ ) in relation to the occlusal plane of the straight line (38) that joins the said notch (13) to the point (14) under the eye (15).

8. Apparatus according to claims 5 and 6, characterized by the fact that the mentioned occlusal plane (5) is basically "U" shaped, the mentioned seat (6) for the graduated rod (3) being provided on the transversal arm (32), some fulcrums (7, 8) being present on the 5 ends of arms (33, 34) that are suitable for receiving, through a sliding connection, the corresponding graduated rod (35) of the mentioned goniometers (10).
9. Apparatus according to claim 1 and to one or more previous claims, characterized by the fact that the mentioned means for reproducing in the laboratory the position of the 10 dental arches include a base (11) and some devices for positioning, in relation to this base, the mentioned plate (1) according to the said values (H, L,  $\alpha$ ).
10. Apparatus according to claim 9, characterized by the fact that the mentioned devices include a rod (18) that has both a supporting seat (20) of the said rod (3) in the position 15 (L) of plate (1) that is supported by the rod itself and a graduated scale (19), that is suitable for reproducing the mentioned value (H) of the position of the plate (1) itself in relation to the occlusal plane, and goniometers (21) for the selection of the mentioned value ( $\alpha$ ) of the position of this plate.
- 20 11. Apparatus according to claim 10, characterized by the fact that it has, on the mentioned base (11), a seat (17) for sliding the said rod (18) for the readout, on the graduated scale (19) of this rod, of the mentioned value (H) of the position of plate (1).
12. Apparatus according to claim 10, characterized by the fact that the said base (11) has 25 the same shape and dimensions as the mentioned occlusal plane (5), the said goniometers (21) being fixed at the ends (39, 40) of this base (11) and being provided with hole transversal seats (22) that coincide with the position of the condylar axis (36).
- 30 13. Apparatus according to claim 12, characterized by the fact that it has some axially sliding pins (23, 24) that are housed in these seats (22) that can be blocked inside by means of a threaded element (25, 26).
14. Apparatus according to one or more of the previous claims, characterized by the fact 35 that it also has an articulator (29) that is supported at the ends (28) of the mentioned pins (23, 24) and is provided with an incisal rod (30) for the support of the articulator itself according to the angulation ( $\alpha$ ) that is read on goniometers (21).

15. Apparatus according to one or more of the previous claims, characterized by the fact that it has a reference (44) on the trasversal rod (45) for centering the articulator (29) in relation to goniometers (21).

5

16. Apparatus according to one or more of the previous claims, characterized by the fact that it also has a fastening screw (12) of the said rod (3) to its seat (6) on the occlusal plane (5), a screw (41) to fasten the rod itself (3) into its seat (20) on the graduated rod (18) and some knobs (27) for holding and manually moving the mentioned pins (23, 24).

10

17. Apparatus according to one or more of the previous claims, characterized by the fact that the said graduated rods (3, 18) are provided with a suitable means that prevents their axial rotation inside their housings.

15

18. Apparatus according to one or more of the previous claims, characterized by the fact that it also has some further devices to center the said plate (1) in relation to the dental arches.

20

19. Apparatus according to claim 18, characterized by the fact that the mentioned further centering devices include a cross (46) that is fastened to the said rod (3).

25

20. Apparatus according to claim 19, characterized by the fact that the said cross (46) includes a vertical arm (47) that is fastened to this rod (3) and a horizontal arm (48) that is fastened at a certain height on the mentioned arm (47), the said arms (47, 48) being suitable for being lined up, in the desired centering position of plate (1), with the middle-line (52) of the patient's face and with his bipupillary plane (43) respectively.

21. Apparatus according to one or more of the previous claims, characterized by the fact that it is provided with a double connecting system of plate (1) to the said rod (3).

30

22. Apparatus according to claim 21, characterized by the fact that the said double connecting system includes an articulated joint (2) and two pre-fracture arms (49, 50), these arms being suitable for being broken, in order to allow for the oscillation movements of the mentioned plate (1) in relation to the rod (3) around the articulated joint (2).

35

23. Apparatus according to the previous claims, characterized by the fact that it is provided with a water level on the occlusal plane (5).

5        24. Apparatus according to the previous claims, characterized by the fact that the said graduated rod (18) also has a bearing plane (48) for the corresponding end of the incisal rod (30), this plane (48) showing a readout scale (49) of the inclination angle ( $\alpha$ ) of the articulation (29) in relation to the mentioned base (11).

10      25. Use of the apparatus according to one or more of the previous claims for the applications in the field of dentistry and dental technique.

1 / 10

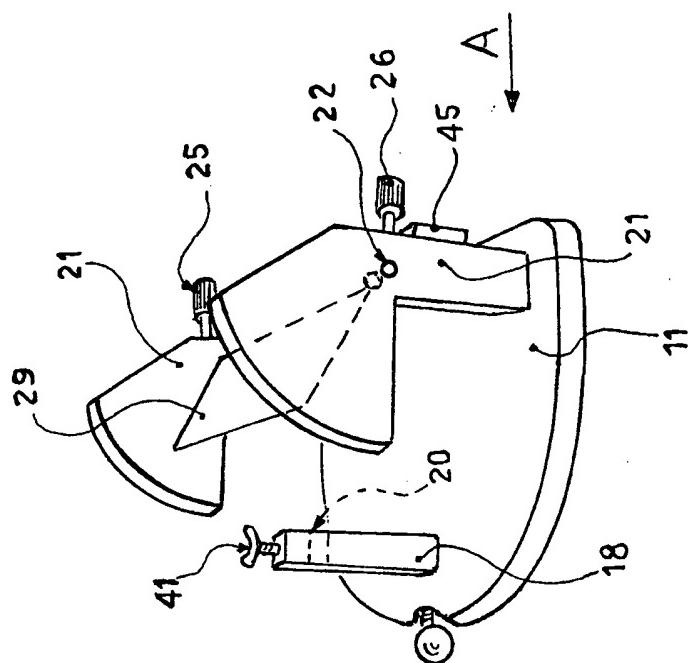


FIG. 1

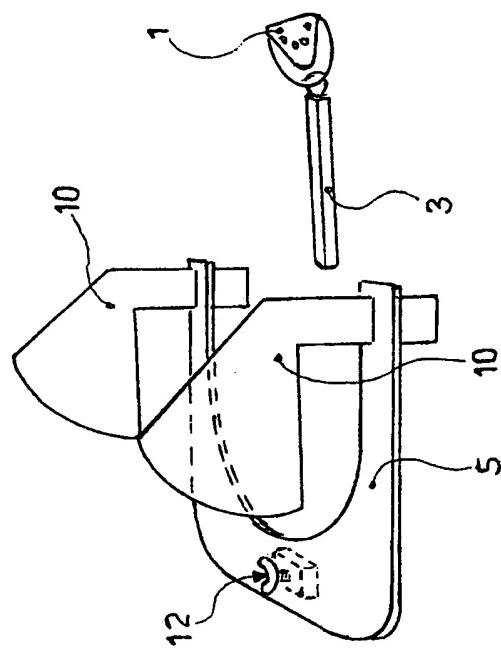
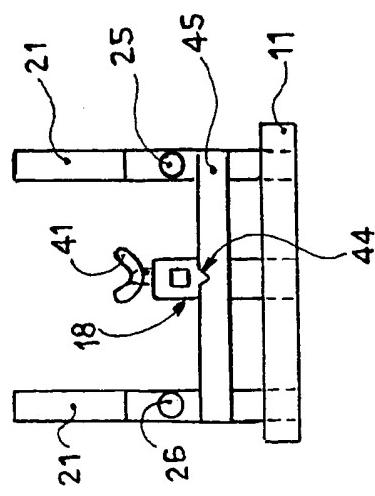


FIG. 1a



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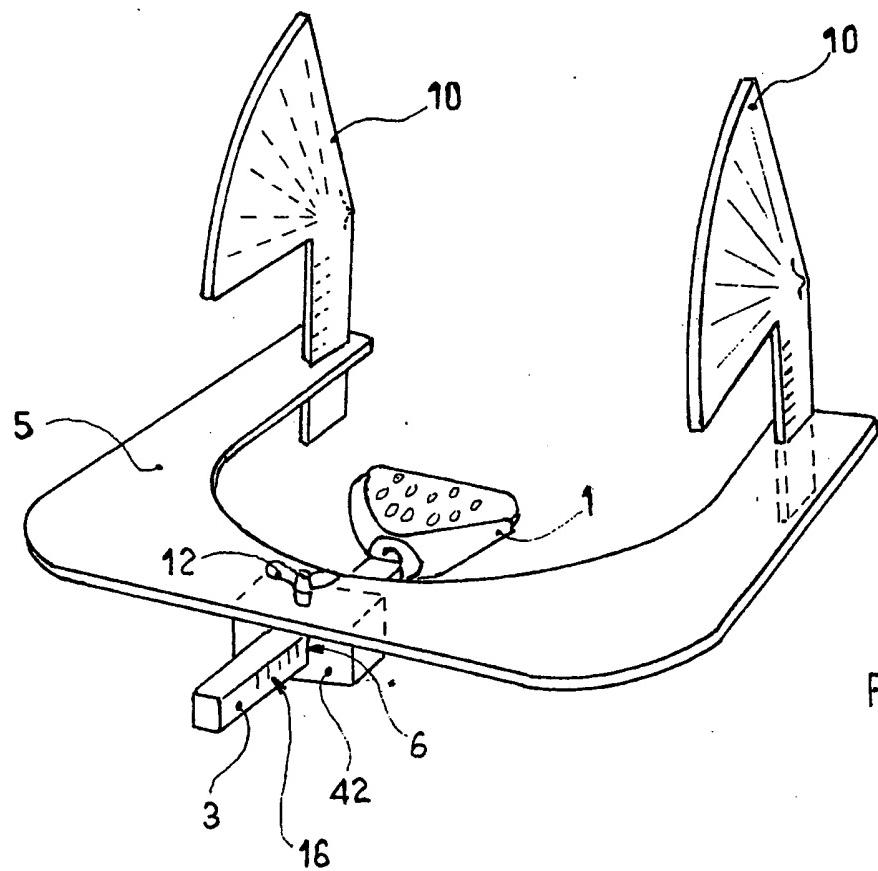


FIG.2

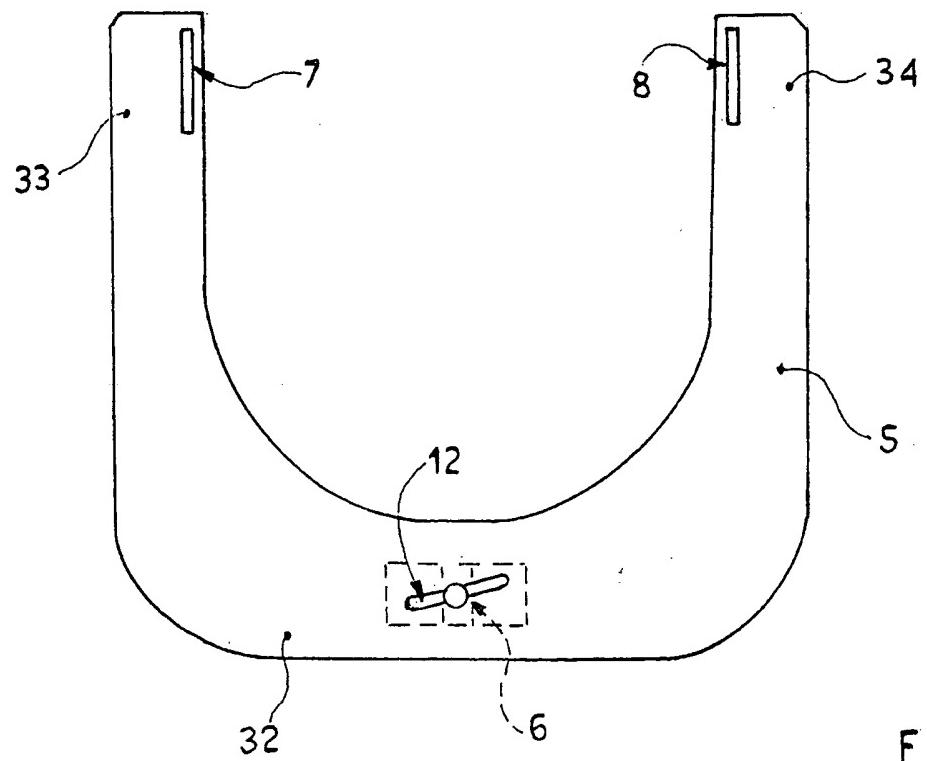


FIG.3

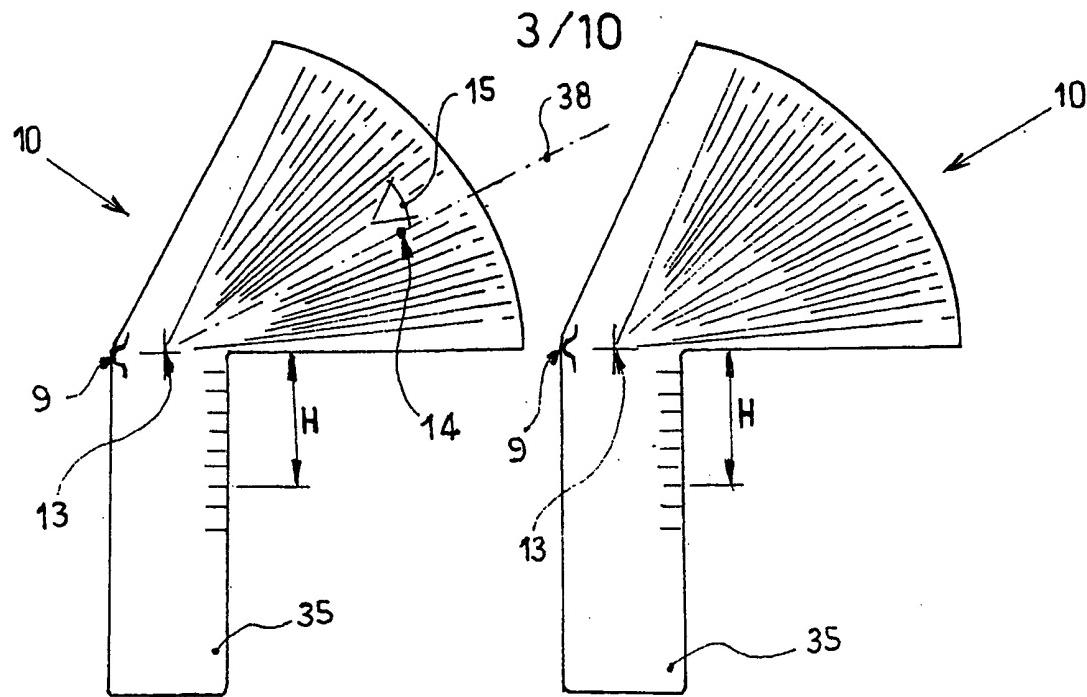


FIG. 4

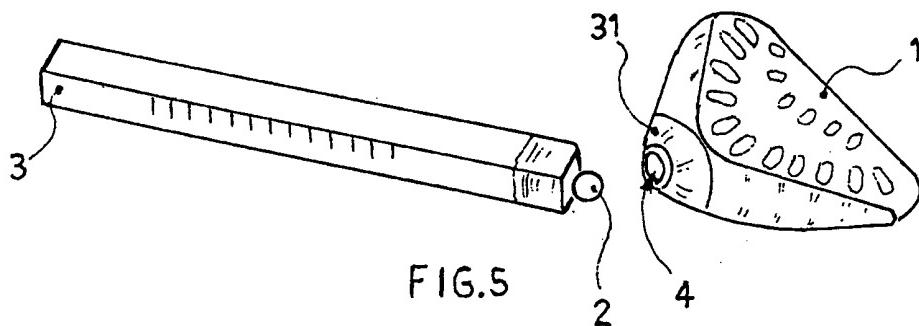


FIG. 5

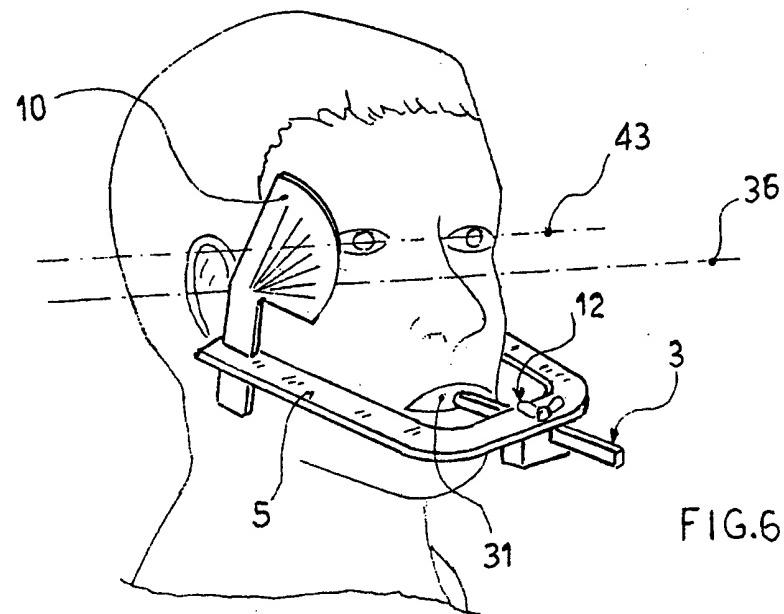


FIG. 6

4 / 10

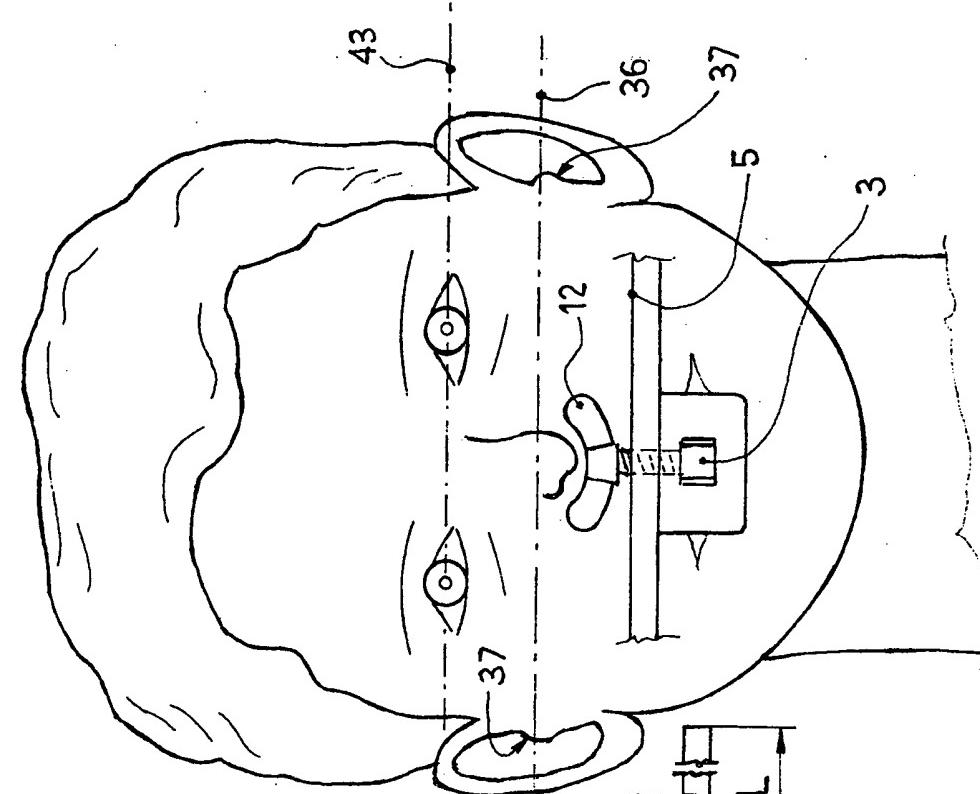


FIG. 8

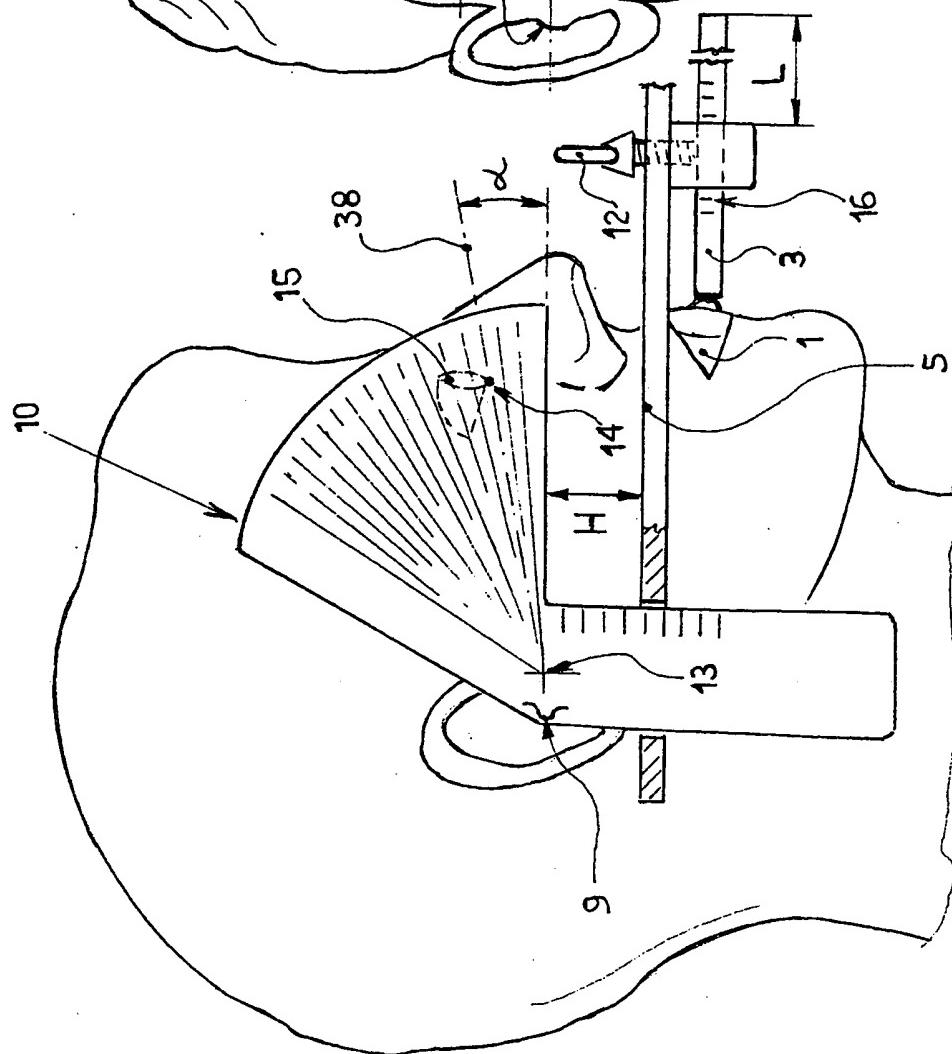


FIG. 7

5 / 10

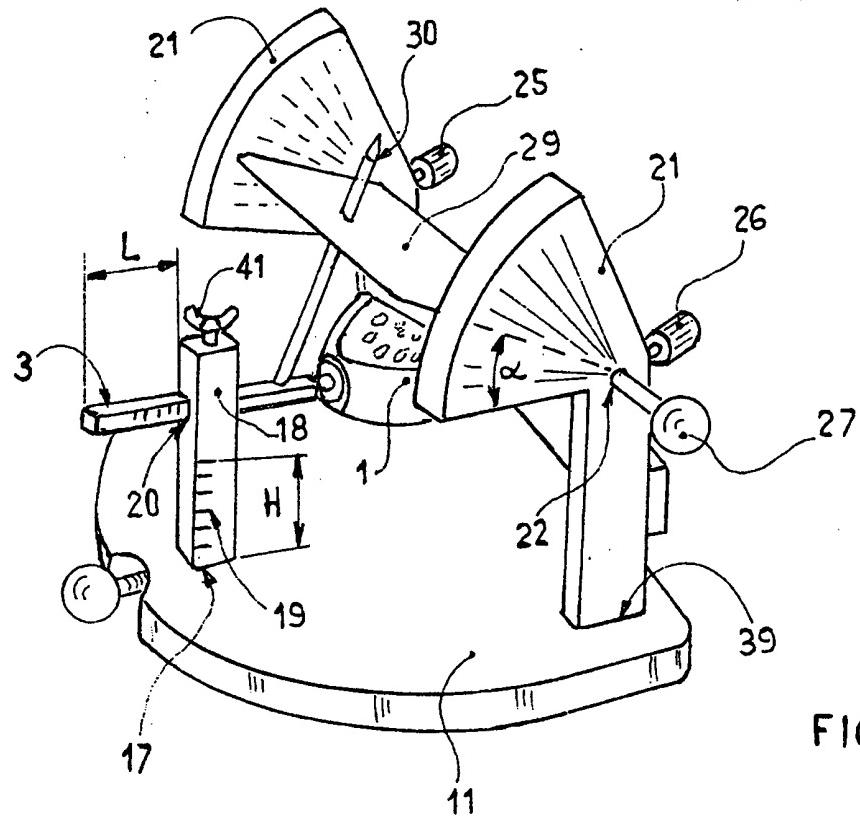


FIG.9

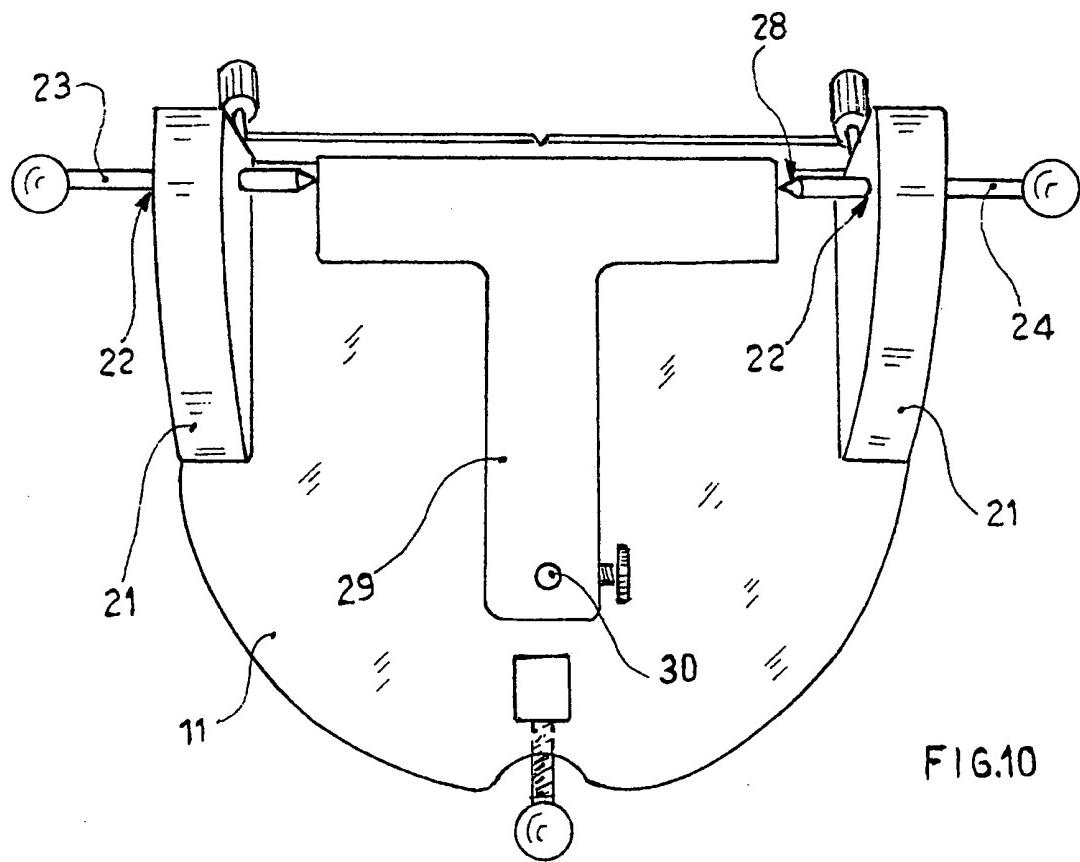


FIG.10

6 / 10

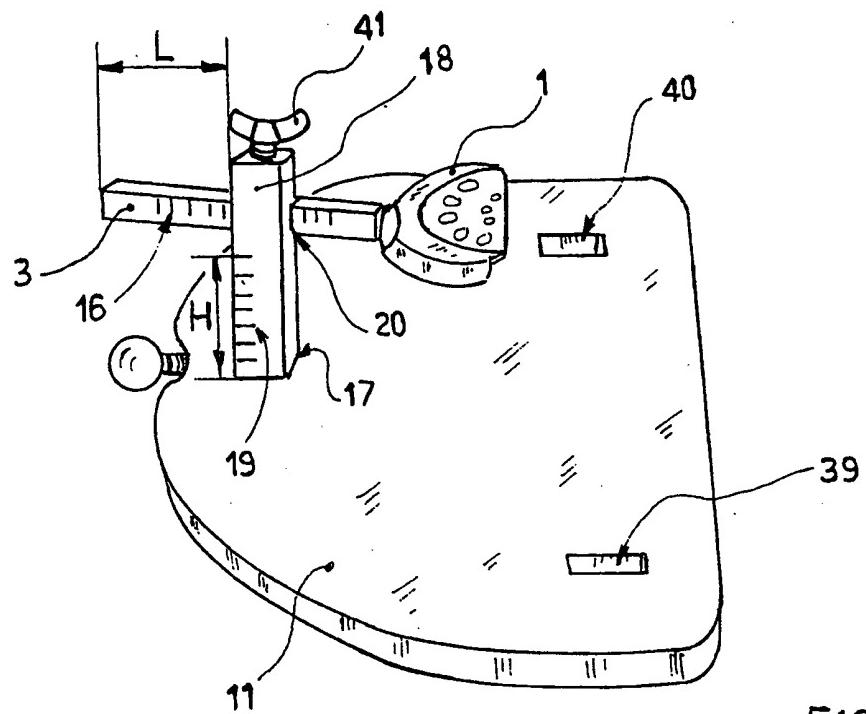


FIG.11

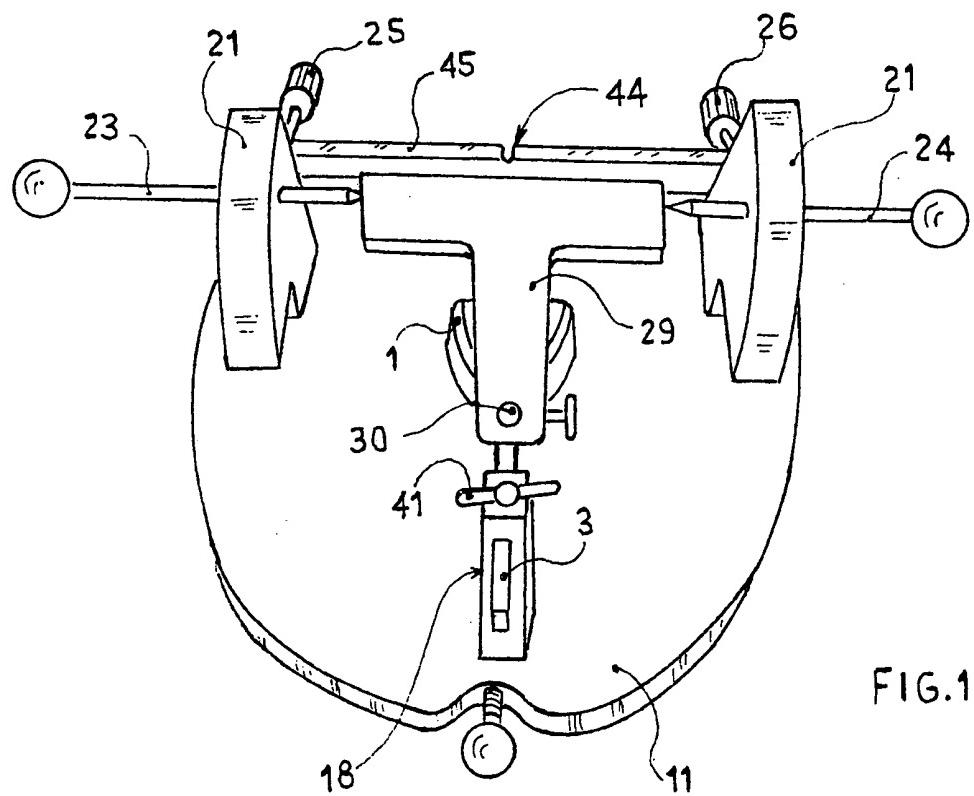


FIG.12

7 / 10

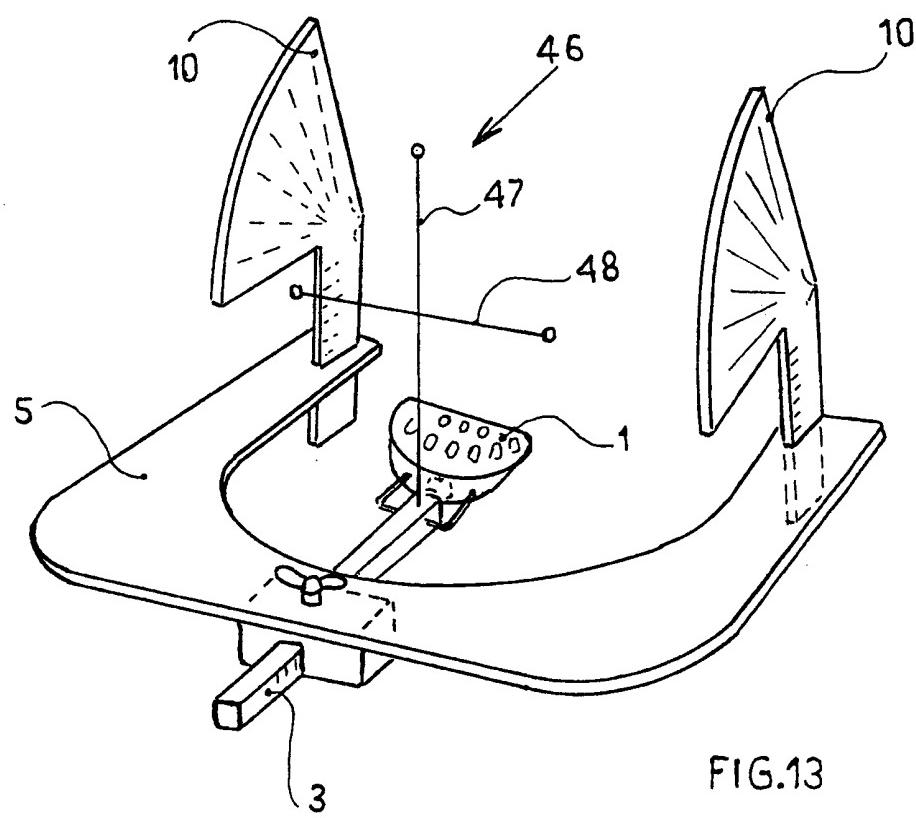
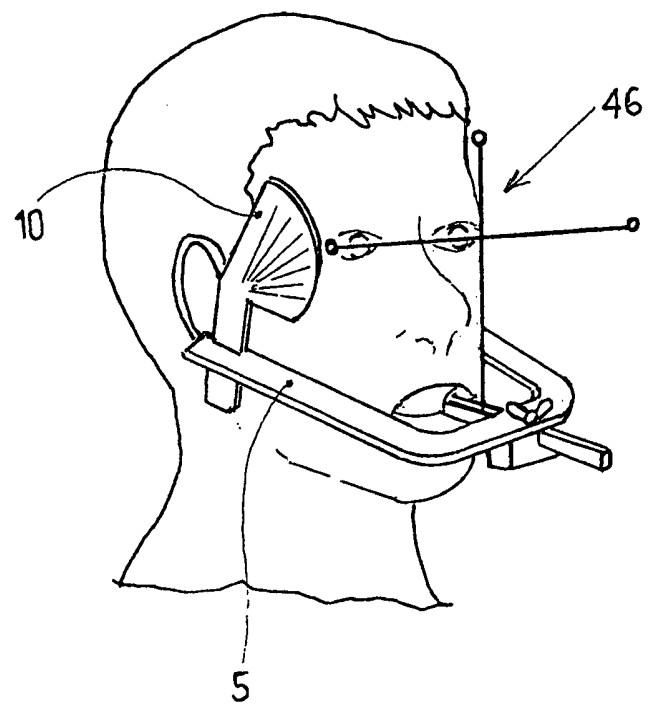
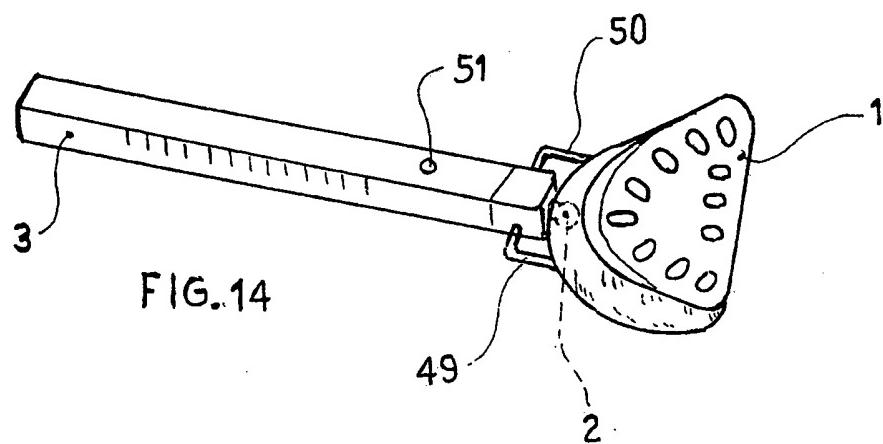


FIG.13

8 / 10



9 / 10

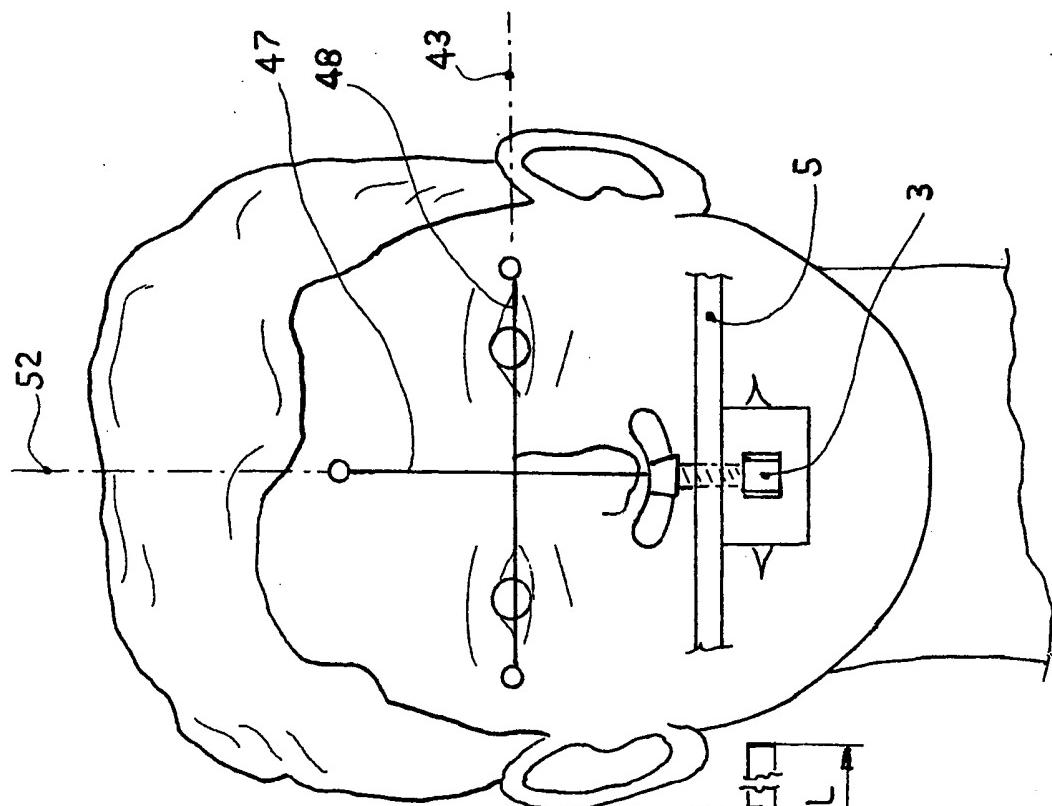


FIG. 17

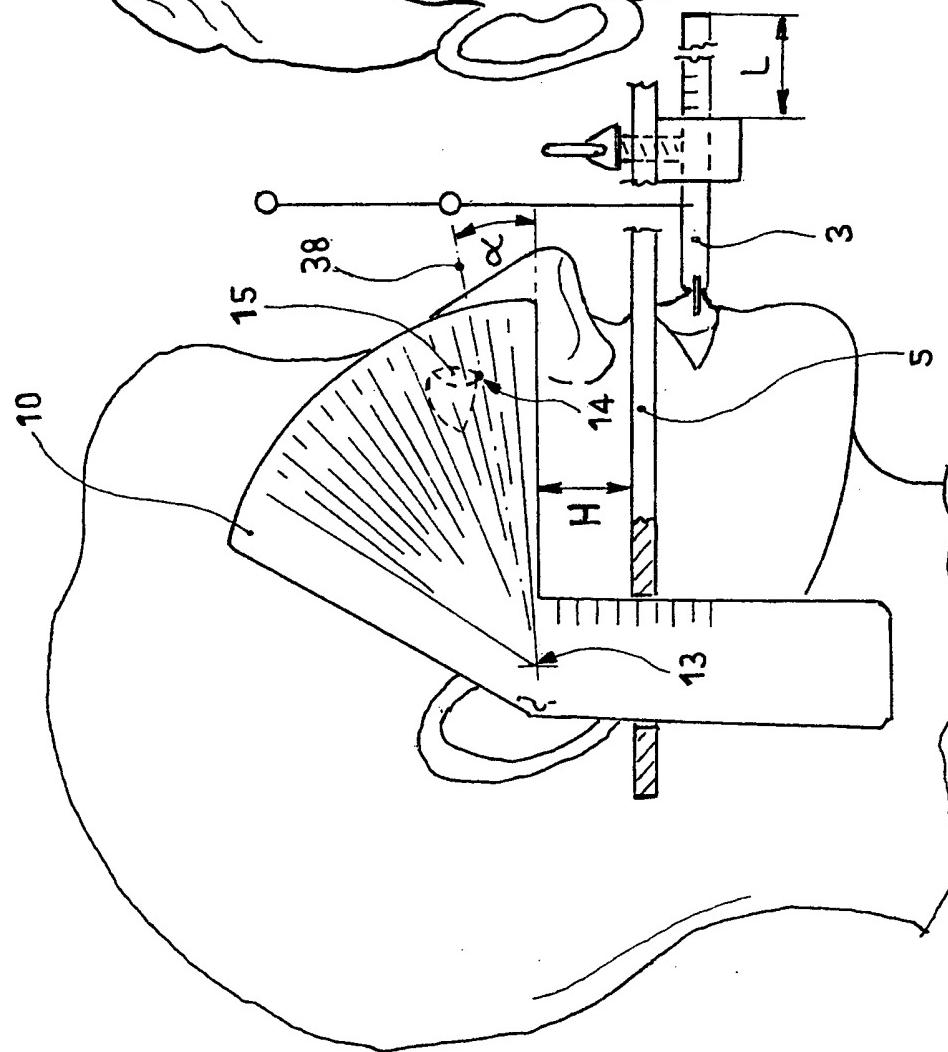


FIG. 16

10 / 10

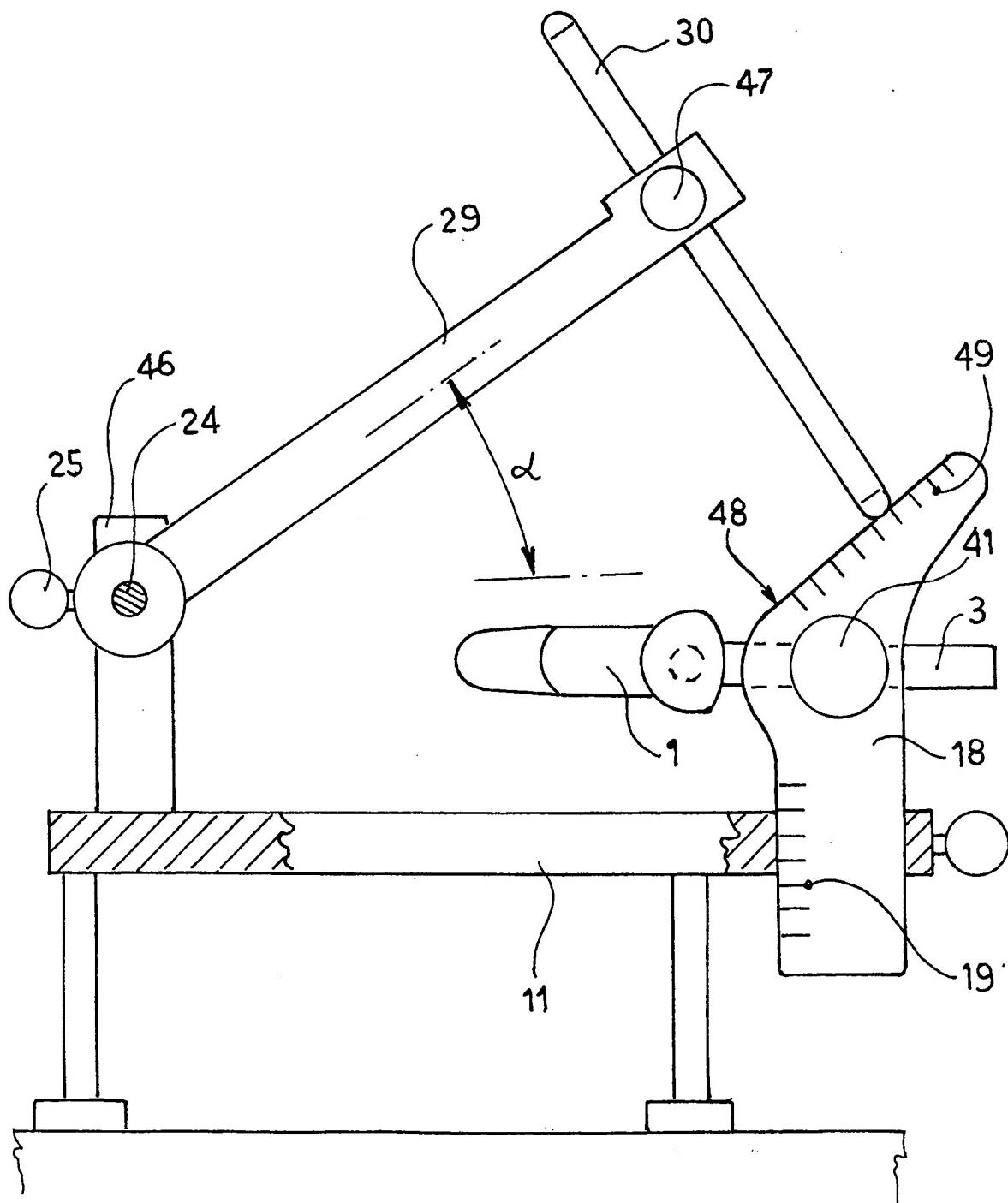


FIG.18

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 00/02622

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 A61C19/045

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 633 006 A (POLZ) 11 January 1995 (1995-01-11)	1
A	the whole document	2-5, 9, 10, 14, 16, 18
A	US 5 078 600 A (AUSTIN) 7 January 1992 (1992-01-07)	1-6
	column 3, line 24 - line 61; figure 1	
A	US 5 176 515 A (ANDREWS) 5 January 1993 (1993-01-05)	1-6, 8-10, 14
	the whole document	
A	US 1 703 105 A (HAWKSFORTH) 26 February 1929 (1929-02-26)	1, 2, 8-10, 14, 16-18
	the whole document	

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

## \* Special categories of cited documents :

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Date of the actual completion of the international search

17 August 2000

Date of mailing of the International search report

24/08/2000

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Vanrunxt, J

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 00/02622

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US 1703105	A	26-02-1929		NONE		